

### **AMENDED CLAIMS**

1. (Currently amended) An electric arc welder for performing a given weld process with selected current waveform performed between an electrode and a workpiece, said welder comprising a controller with a digital processor, a sensor for reading the instantaneous weld current, and a circuit to convert said instantaneous current into a digital representation of the level of said instantaneous weld current, said digital processor having a program circuit to periodically read and square said digital representation at a given rate, a register for summing a number N of said square digital representation to give a summed value, and an algorithm for periodically dividing the summed value by said number N to provide a quotient and then taking the square root of said quotient to thereby digitally construct a rms signal representing the root mean square of said weld current over the current waveform period.

2. (Original) An electric arc welder as defined in claim 1 wherein said controller includes a feedback control loop with an error detector for generating a current control signal based upon the relationship of two signals, the first signal of which includes said rms signal.

3. (Currently amended) ~~An electric arc welder as defined in claim 2 for performing a given weld process with selected current waveform performed between an electrode and a workpiece, said welder comprising a controller with a digital processor, a sensor for reading the instantaneous weld current, and a circuit to convert said instantaneous current into a digital representation of the level of said instantaneous weld current, said digital processor having a program circuit to periodically read and square said digital representation at a given rate, a register for summing a number N of said square digital representation to give a summed value, and an algorithm for periodically dividing the summed value by said number N to provide a quotient and then taking the square root of said quotient to thereby digitally construct a rms signal representing the root mean square of said weld current, and further including a circuit to create an average current signal representing the average weld current and a summing circuit to create said a first signal by adding values proportional to said rms signal and said average signal, said controller further including a feedback control loop with an error detector for generating a current control signal based upon the relationship of two signals, the first of which includes the first signal.~~

4. (Original) An electric arc welder as defined in claim 3 wherein said first signal includes a first contributing component equal to a times average current signal and b times said rms signal.
5. (Original) An electric arc welder as defined in claim 4 wherein  $a+b=1$ .
6. (Original) An electric arc welder as defined in claim 5 wherein b is greater than a.
7. (Original) An electric arc welder as defined in claim 4 wherein b is greater than a.
8. (Original) An electric arc welder as defined in claim 3 wherein said first signal includes a first contributing component equal to a times average current signal and b times said rms signal.
9. (Original) An electric arc welder as defined in claim 8 wherein  $a+b=1$ .
10. (Original) An electric arc welder as defined in claim 9 wherein b is greater than a.
11. (Original) An electric arc welder as defined in claim 8 wherein b is greater than a.
12. (Original) An electric arc welder as defined in claim 11 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.
13. (Original) An electric arc welder as defined in claim 10 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.
14. (Original) An electric arc welder as defined in claim 9 wherein said

waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

15. (Original) An electric arc welder as defined in claim 8 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

16. (Original) An electric arc welder as defined in claim 7 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

17. (Original) An electric arc welder as defined in claim 6 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

18. (Original) An electric arc welder as defined in claim 5 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

19. (Original) An electric arc welder as defined in claim 4 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

20. (Original) An electric arc welder as defined in claim 3 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

21. (Original) An electric arc welder as defined in claim 2 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

22. (Original) An electric arc welder as defined in claim 1 wherein said waveform is created by a number of current pulses occurring at a frequency of at least

18 kHz with a magnitude of each pulse controlled by a wave shaper.

23. (Original) An electric arc welder as defined in claim 1 wherein said given rate is less than about 40 kHz.

24. (Original) An electric arc welder as defined in claim 1 wherein said given rate is in the general range of 100 kHz to 5 kHz.

25. (Original) An electric arc welder as defined in claim 24 wherein said digital processor has a first and second register for summing said squared digital representations, a circuit controlled by said waveform to create an event signal at a given location in said waveform, and a program to alternate said first and second register upon creation of said event signal.

26. (Original) An electric arc welder as defined in claim 22 wherein said digital processor has a first and second register for summing said squared digital representations, a circuit controlled by said waveform to create an event signal at a given location in said waveform, and a program to alternate said first and second register upon creation of said event signal.

27. (Original) An electric arc welder as defined in claim 2 wherein said digital processor has a first and second register for summing said squared digital representations, a circuit controlled by said waveform to create an event signal at a given location in said waveform, and a program to alternate said first and second register upon creation of said event signal.

28. (Currently amended) An electric arc welder as defined in claim 1 wherein for performing a given weld process with selected current waveform performed between an electrode and a workpiece, said welder comprising a controller with a digital processor, a sensor for reading the instantaneous weld current, and a circuit to convert said instantaneous current into a digital representation of the level of said instantaneous weld current, said digital processor has having a program circuit to periodically read and square said digital representation at a given rate, a first and second register for summing a number N of said squared digital representations to give a summed value,

an algorithm for periodically dividing the summed value by said number N to provide a quotient and then taking the square root of said quotient to thereby digitally construct a rms signal representing the root mean square of said weld current, said [[a]] circuit being controlled by said waveform to create an event signal at a given location in said waveform[[.]] and a program to alternate said first and second register upon creation of said event signal.

29. (Original) An electric arc welder as defined in claim 28 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

30. (Original) An electric arc welder as defined in claim 27 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

31. (Original) An electric arc welder as defined in claim 26 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

32. (Original) An electric arc welder as defined in claim 25 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

33. (Original) An electric arc welder as defined in claim 24 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

34. (Original) An electric arc welder as defined in claim 23 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

35. (Original) An electric arc welder as defined in claim 22 wherein said digital

processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

36. (Original) An electric arc welder as defined in claim 21 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

37. (Original) An electric arc welder as defined in claim 20 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

38. (Original) An electric arc welder as defined in claim 4 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

39. (Original) An electric arc welder as defined in claim 3 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

40. (Original) An electric arc welder as defined in claim 2 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

41. (Original) An electric arc welder as defined in claim 1 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

42. (Original) An electric arc welder as defined in claim 41 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

43. (Original) An electric arc welder as defined in claim 40 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

44. (Original) An electric arc welder as defined in claim 39 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

45. (Original) An electric arc welder as defined in claim 38 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

46. (Original) An electric arc welder as defined in claim 42 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

47. (Original) An electric arc welder as defined in claim 41 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

48. (Original) An electric arc welder as defined in claim 40 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

49. (Original) An electric arc welder as defined in claim 39 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

50. (Original) An electric arc welder as defined in claim 33 including a digital counter to count at said given rate to obtain the number N upon creation of said event

signal.

51. (Original) An electric arc welder as defined in claim 32 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

52. (Original) An electric arc welder as defined in claim 28 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

53. (Original) An electric arc welder as defined in claim 27 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

54. (Original) An electric arc welder as defined in claim 25 including a digital counter to count at said given rate to obtain the number N upon creation of said event signal.

55-64. (Canceled)

65. (Currently amended) A An electric arc welder as defined in claim 64 wherein said current signal is for performing a given welding process with a selected current waveform performed between an electrode and a workpiece, said welder comprising a controller with a digital processor, a sensor for reading the instantaneous weld current of said waveform and a circuit to convert said instantaneous weld current into a digital representation of the level of said instantaneous weld current, said digital processor having a program circuit to periodically read said digital representation at a given rate and an algorithm for processing said digital representations into a current root mean square (rms) signal in which the mean is taken over at least a contiguous current waveform period.

66. (Original) An electric arc welder as defined in claim 65 wherein said controller includes a feedback control loop with an error detector for generating a current control signal based upon the relationship of two signals, the first signal of which



includes said rms signal.

67. (Original) An electric arc welder as defined in claim 66 including a circuit to create an average current signal representing the average weld current and a summing circuit to create said first signal by adding values proportional to said rms signal and said average signal.

68. (Original) An electric arc welder as defined in claim 67 wherein said first signal includes a first contributing component equal to a times average current signal and b times said rms signal.

69. (Original) An electric arc welder as defined in claim 68 wherein  $a+b=1$ .

70. (Original) An electric arc welder as defined in claim 67 wherein  $a+b=1$ .

71. (Original) An electric arc welder as defined in claim 70 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

72. (Original) An electric arc welder as defined in claim 67 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

73. (Original) An electric arc welder as defined in claim 68 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

74. (Original) An electric arc welder as defined in claim 67 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

75. (Original) An electric arc welder as defined in claim 66 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

76. (Original) An electric arc welder as defined in claim 65 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

77-80. (Canceled)

81. (Original) An electric arc welder as defined in claim 65 wherein said given rate is less than about 40 kHz.

82. (Original) An electric arc welder as defined in claim 65 wherein said given rate is in the general range of 100 kHz to 5 kHz.

83. (Original) An electric arc welder as defined in claim 65 wherein said digital processor includes a circuit controlled by said waveform to create an event signal at a given location in said waveform and a program to initiate said algorithm upon creation of said event signal.

84. (Currently amended) An electric arc welder for performing a given weld process with a selected current waveform performed between an electrode and a workpiece, said welder comprising a controller with a digital processor, said controller having a waveform generator for creating a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude for each pulse creating said waveform and a feedback current control loop with an error detector for generating a current control signal based upon the relationship of two signals, the first signal of which includes an actual rms current signal over the whole waveform generated by an algorithm processed by said digital processor.

85. (Original) A welder as defined in claim 84 wherein said second of said two signals is a signal representing the desired current rms signal.

86. (Original) An electric arc welder as defined in claim 85 wherein said first signal includes a first contributing component equal to a times average current signal and b times said rms signal.

87. (Original) An electric arc welder as defined in claim 84 wherein said first signal includes a first contributing component equal to a times average current signal and b times said rms signal.
88. (Original) An electric arc welder as defined in claim 87 wherein  $a+b=1$ .
89. (Original) An electric arc welder as defined in claim 88 wherein b is greater than a.
90. (Original) An electric arc welder as defined in claim 87 wherein b is greater than a.
91. (Original) An electric arc welder as defined in claim 85 wherein said given rate is less than about 40 kHz.
92. (Original) An electric arc welder as defined in claim 84 wherein said given rate is less than about 40 kHz.
93. (Original) An electric arc welder as defined in claim 85 wherein said given rate is in the general range of 100 kHz to 5 kHz.
94. (Original) An electric arc welder as defined in claim 84 wherein said given rate is in the general range of 100 kHz to 5 kHz.
95. (Original) A method of operating an electric arc welder for performing a given weld process with selected current waveform performed between an electrode and a workpiece, said welder comprising a controller with a digital processor, said method comprising:
- (a) reading the instantaneous weld current;
  - (b) converting said instantaneous current into a digital representation of the level of said instantaneous weld current;
  - (c) periodically reading and squaring said digital representation at a given rate;

- (d) summing a number N of said square digital representation to give a summed value;
- (e) periodically dividing and summed value by said number N to provide a quotient; and,
- (f) then taking the square root of said quotient to thereby digitally construct a signal rms representing the root mean square of said weld current.

96. (Original) A method as defined in claim 95 wherein said controller includes a feedback control loop with an error detector and the method includes generating a current control signal by said error detector based upon the relationship of two signals, the first signal of which includes said rms signal.

- 97. (Original) A method as defined in claim 95 including:
  - (g) creating an average current signal representing the average weld current;
 and,
  - (h) creating said first signal by adding values proportional to said rms signal and said average signal.

98. (Original) A method as defined in claim 95 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

99. (Original) A method as defined in claim 95 wherein said given rate is less than about 40 kHz.

100. (Original) A method as defined in claim 95 wherein said given rate is in the general range of 100 kHz to 5 kHz.

101. (Original) An electric arc welder for performing a given weld process with a selected current waveform between an electrode and workpiece, said welder comprising: a circuit to sample the weld current of said waveform at a given rate, a detector to create an event signal at a given location in said waveform, a counter to count the number of samples between successive event signals, a digital processor with an algorithm to calculate a rms value for the weld current based upon said samples

and said number.

102. (Original) An electric arc welder as defined in claim 101 wherein said current waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with the magnitude of each pulse controlled by a wave shaper.

103. (Original) An electric arc welder as defined in claim 102 wherein said given rate is less than about 40 kHz.

104. (Original) An electric arc welder as defined in claim 102 wherein said given rate is in the general range of 100 kHz to 5 kHz.

105. (Original) An electric arc welder as defined in claim 101 wherein said given rate is less than about 40 kHz.

106. (Original) An electric arc welder as defined in claim 101 wherein said given rate is in the general range of 100 kHz to 5 kHz.

107. (Original) A method of operating an electric arc welder for performing a given weld process with a selected current waveform between an electrode and a workpiece, said method comprising:

- (a) sampling the weld current of said waveform at a given rate;
- (b) creating an event signal at a given location in said waveform;
- (c) counting the number of samples between successive event signals; and,
- (d) calculating a rms value for the weld current based upon said samples and said number.

108. (Original) A method as defined in claim 107 comprising:

- (e) creating said current waveform by a number of current pulses occurring at a frequency of at least 18 kHz; and,
- (f) controlling the magnitude of each pulse by a wave shaper.

109. (Original) A method as defined in claim 108 wherein said given rate is less than about 40 kHz.

110. (Original) A method as defined in claim 107 wherein said given rate is less than about 40 kHz.

111. (Original) A method as defined in claim 107 wherein said given rate is in the range of 100 kHz to 5 kHz.

112. (Original) A method as defined in claim 108 wherein said given rate is in the range of 100 kHz to 5 kHz.

113-138. (Canceled)

139. (Original) An electric arc welder for performing a given weld process with a selected waveform performed between an electrode and a workpiece, said welder comprising a power source, a circuit for calculating the rms current of said power source, a circuit for determining the average current of said power source and a controller with a closed loop current feedback circuit responsive to a combination of said rms current and said average current.

140. (Original) An electric arc welder as defined in claim 139 wherein said combination includes a substantially higher rms current component.

141. (New) An electric arc welder for performing a given weld process with selected current waveform performed between an electrode and a workpiece, said welder comprising:

a digitizing sensor for acquiring instantaneous digital values of at least one weld parameter; and

a digital controller that (i) digitally squares the acquired instantaneous digital values and digitally constructs at least one root-mean-square (rms) signal from digitally squared values acquired over at least one period of the current waveform, the at least one rms signal being representative of the at least one weld parameter over the at least one period of the current waveform, and (ii) generates at least one weld control signal based on the at least one digitally constructed rms signal.

142. (New) An electric arc welder as set forth in claim 141 wherein the at least one weld parameter includes at least weld current, and the at least one rms signal includes an rms current representative of the weld current over the at least one period of the current waveform.

143. (New) An electric arc welder as set forth in claim 141 wherein the at least one weld control signal includes a wire feed speed control signal.

144. (New) An electric arc welder as set forth in claim 143 wherein the at least one weld parameter includes a weld voltage, the wire feed speed control signal being generated based on the digitally constructed rms signal corresponding to the weld voltage.

145. (New) An electric arc welder as set forth in claim 141 wherein the at least one weld parameter includes at least weld voltage.

146. (New) An electric arc welder as set forth in claim 141 wherein the at least one weld parameter includes at least weld current and weld voltage.

147. (New) An electric arc welder for performing a pulse welding process with a selected waveform performed between an electrode and workpiece, said welder comprising:

- a power source with a waveform generator having at least one control signal input;

- a sensor monitoring at least one monitored weld parameter;

- a digitizer that digitizes the sensor output to generate digital instantaneous weld parameter samples corresponding to the at least one monitored weld parameter; and

- a digital controller that (i) digitally computes at least one root-mean-square (rms) value corresponding to the at least one monitored weld parameter in which the mean is taken over a contiguous time interval spanning at least one period of the waveform and (ii) computes, based on the at least one rms value, at least one control signal that is input to the at least one control signal input of the power source.

148. (New) A welder as set forth in claim 147, wherein the at least one

monitored weld parameter includes weld current.

149. (New) A welder as set forth in claim 147, wherein the digital controller computes at least a wire feed speed control signal.

150. (New) A welder as set forth in claim 149, wherein the at least one monitored weld parameter includes weld voltage, and the wire feed speed control signal is computed based on the rms value corresponding to the weld voltage.

151. (New) A welder as set forth in claim 147, wherein the at least one monitored weld parameter includes weld current and weld voltage, and the at least one control signal is computed based on a power factor derived from the digitally computed rms values corresponding to weld current and weld voltage.

152. (New) A welder as set forth in claim 147, wherein the at least one control signal includes a waveform shape control signal whose value determines a shape of the selected waveform.

153. (New) A welder as set forth in claim 152, wherein the at least one monitored weld parameter includes weld current, and the waveform shape control signal is computed based on the rms value corresponding to the weld current.